SPECIFICATION

AMPLIFIER APPARATUS AND ACOUSTIC SYSTEM

TECHNICAL FIELD OF THE INVENTION

[0001]

The present invention relates to an amplifier apparatus having an acoustic gain to be changed by audio mixers, the amplifier apparatus being adapted to amplify an analog sound signal received from a microphone in a broadcast studio, a multipurpose hall or the like, and an acoustic system comprising the amplifier apparatus.

DESCRIPTION OF THE RELATED ART

[0002]

As a conventional acoustic system to be used in, for example, a broadcast studio and a multipurpose hall, there has been known an acoustic system which comprises a head amplifier for amplifying an analog sound signal received from a microphone, an analog-to-digital converter for converting the amplified analog sound signal to a digital sound signal to be outputted to an audio mixer, and a controlling apparatus for adjusting an acoustic gain of the head amplifier (See patent document 1).

[0003]

In the broadcast studio or the multipurpose hall having two audio mixers located therein, the acoustic system **5**, as shown in FIG. **6**, further comprises an analog distributor **52** for receiving an analog sound signal from a microphone **51**, and producing two analog sound signals to be outputted to the audio mixers **50a** and **50b** through head amplifiers **53a** and **53b** and analog-to-digital converters **54a** and **54b**. The head amplifiers **53a** and **53b** are adapted to amplify the analog sound signals received from the analog distributor **52**, and to output the amplified analog sound signal to the analog-to-digital converters **54a** and **54b**. The analog-to-digital converters **54a** and **54b** are adapted to receive the amplified analog sound signals from the head amplifiers **53a** and **53b**, and to convert the received analog sound signals to digital sound signals to be respectively outputted to the audio mixers **50a** and **50b**.

[0004]

Patent document 1: Jpn. unexamined patent publication No. 9-135135 (page 3, FIG. 1)

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

The above-mentioned conventional acoustic system, however, encounters such a problem that the analog sound signal to be received by each of the head amplifiers tends to be deteriorated by reason that the analog sound signal is distributed by the analog distributor to each of the head amplifiers through a relatively long analog transmission line.

[0006]

It is, therefore, an object of the present invention to provide an amplifier apparatus which can process the analog sound signal at a relatively high quality with no analog distributor, and to provide an acoustic system comprising the amplifier apparatus.

MEANS FOR SOLVING THE PROBLEMS

[0007]

The amplifier apparatus according to the present invention, comprises: first amplifying means for amplifying an analog sound signal according to a first acoustic gain; converting means for converting the amplified analog sound signal to a digital sound signal; second amplifying means for amplifying, according to a second acoustic gain, the digital sound signal converted by the converting means; and controlling means for obtaining a combined acoustic gain from the first and second acoustic gains, and keeping the combined acoustic gain constant by modifying the second acoustic gain in response to a change of the first acoustic gain.

[0008]

The amplifier apparatus thus constructed according to the present invention can output the digital sound signal to the audio mixers from the analog-to-digital converter at a relatively high quality.

[0009]

The acoustic system according to the present invention, comprises: a plurality of audio mixers; and at least one amplifier apparatus for outputting digital sound signals to the audio mixers, the amplifier apparatus including first amplifying means for amplifying an analog sound signal according to a first acoustic gain, converting means for converting the amplified analog sound signal to a digital sound signal, second amplifying means for amplifying, according to a second acoustic gain, the digital sound signal converted by the converting means, a plurality of third amplifying means for amplifying, according to respective third acoustic gains, the digital sound signal amplified by the second amplifying means, and controlling means for obtaining a combined acoustic gain from the first and second acoustic gains, and keeping the combined acoustic gain constant by modifying the second acoustic gain in response to a change of the first acoustic gain, wherein the

converting means is adapted to output the converted digital sound signal to one of the audio mixers, the third amplifying means is adapted to output the amplified digital sound signals to the remaining audio mixers, said one audio mixer is adapted to output to the controlling means a control signal indicative of an instruction to change the first acoustic gain, and to allow the controlling means to obtain a combined acoustic gain from the first and second acoustic gains, and to keep the combined acoustic gain constant by modifying the second acoustic gain in response to a change of the first acoustic gain, and each of the remaining audio mixers is adapted to output to the controlling means a control signal indicative of an instruction to change the third acoustic gain, and to allow the controlling means to change the third acoustic gain of the third amplifier.

[0010]

The acoustic system thus constructed according to the present invention can output the digital sound signal to the audio mixers at a relatively high quality, and allow the acoustic gain of the amplifier to be changed by each of the audio mixers.

[0011]

The acoustic system according to the present invention, comprises: a plurality of audio mixers; and at least one amplifier apparatus for outputting digital sound signals to the audio mixers, wherein the amplifier apparatus includes first amplifying means for amplifying an analog sound signal according to a first acoustic gain, converting means for converting the amplified analog sound signal to a digital sound signal, second amplifying means for amplifying, according to a second acoustic gain, the digital sound signal converted by the converting means, a plurality of third amplifying means for amplifying, according to respective third acoustic gains, the digital sound signal amplified by the second amplifying means, registering means for registering one of the audio mixers as a main mixer, and registering each of the remaining audio mixers as a secondary mixer, and controlling means for preventing the second and third acoustic gains from being changed by said one audio mixer, having said one audio mixer receive the digital sound signal from the converting means, obtaining a combined acoustic gain from the first and second acoustic gains, keeping the combined acoustic gain constant by modifying the second acoustic gain in response to a change of the first acoustic gain, and having the remaining audio mixers receive the respective digital sound signals from the third amplifying means.

[0012]

The acoustic system thus constructed according to the present invention can allow one of the audio mixers to be set as an audio mixer which is capable of changing the first acoustic gain of the first amplifier, and allow each of the audio mixers to change the acoustic gain.

[0013]

In the acoustic system according to the present invention, the controlling means includes a detecting unit for detecting the change of the first acoustic gain, and a judging unit for judging whether or not the first acoustic gain is changed on the basis of information obtained from the detecting unit, starting to compute an elapsed time when the judgment is made that the first acoustic gain is changed, and judging whether or not the computed elapsed time exceeds a predetermined value. The controlling means is adapted to allow the second acoustic gain to be modified in response to the change of the first acoustic gain when the judgment is made by the judging unit that the computed elapsed time exceeds the predetermined value.

[0014]

The acoustic system thus constructed according to the present invention can keep the sum of the first and second acoustic gains constant even if the main mixer changes the first acoustic gain.

ADVANTAGEOUS EFFECT OF THE INVENTION

[0015]

Each of the amplifier apparatus and the acoustic system provided with the amplifier apparatus can process the analog sound signal at a relatively high quality with no analog distributor by reason that the amplifier apparatus comprises first amplifying means having a first acoustic gain, the first amplifying means being adapted to amplify the analog sound signal according to the first acoustic gain, converting means for converting the amplified analog sound signal to a digital sound signal, second amplifying means having a second acoustic gain, the second amplifying means being adapted to amplify, according to the second acoustic gain, the digital sound signal converted by the converting means, and controlling means for obtaining a combined acoustic gain from the first and second acoustic gains, and keeping the combined acoustic gain constant by modifying the second acoustic gain in response to a change of the first acoustic gain.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

[FIG. 1] FIG. **1** is a block diagram showing the construction of the first embodiment of the amplifier apparatus and the acoustic system according to the present invention.

[FIG. 2] FIG. **2** is a schematic view showing the construction of the first embodiment of the acoustic system according to the present invention.

[FIG. 3] FIG. **3** is a flow chart showing the operation of the first embodiment of the

amplifier apparatus and the acoustic system according to the present invention.

[FIG. 4] FIG. **4** is a block diagram showing the construction of the second embodiment of the amplifier apparatus and the acoustic system according to the present invention.

[FIG. 5] FIG. **5** is a block diagram showing the construction of the third embodiment of the amplifier apparatus and the acoustic system according to the present invention.

[FIG. 6] FIG. **6** is a block diagram showing the construction of the conventional acoustic system.

EXPLANATION OF THE REFERENCE NUMERALS

[0017]

1, 2, 3 acoustic system
10a, 10b, 10c audio mixer
11 microphone
12 amplifier apparatus
13 first amplifier
14 analog-to-digital converter
15 second amplifier
16 controller
16a detecting unit
16b judging unit
17b, 17c third amplifier
20a, 20b, 20c audio mixer
21 microphone
22 amplifier apparatus
23 first amplifier
24 analog-to-digital converter
25 second amplifier
27a, 27b, 27c third amplifier
26 controller
26a detecting unit
26b judging unit
26c setting unit
30a, 30b, 30c audio mixer
31 microphone
32 amplifier apparatus
33 first amplifier

34 analog-to-digital converter
35 second amplifier
36 controller
36a detecting unit
36b judging unit
36c setting unit
37a, 37b, 37c third amplifier

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018]

The first embodiment of the amplifier apparatus and the acoustic system according to the present invention will be described hereinafter with reference to the accompanying drawings.

[0019]

FIG. **1** is a block diagram showing the construction of the amplifier apparatus and the acoustic system according to the first embodiment of the present invention.

[0020]

As shown in FIG. **1**, the acoustic system **1** comprises a plurality of audio mixers **10a**, **10b**, and **10c**, a microphone **11** for converting a sound to an analog sound signal, and an amplifier apparatus **12** for amplifying the analog sound signal outputted by the microphone **11**.

[0021]

The amplifier apparatus **12** includes a first amplifier **13** having a first acoustic gain which is variable, the first amplifier **13** being adapted to amplify the converted analog sound signal according to the first acoustic gain, an analog-to-digital converter **14** for converting the amplified analog sound signal to a digital sound signal, a second amplifier **15** having a second acoustic gain which is variable, the second amplifier **15** being adapted to amplify, according to the second acoustic gain, the digital sound signal converted by the analog-to-digital converter **14**, a controller **16** for obtaining a combined acoustic gain from the first and second acoustic gains, and keeping the combined acoustic gain constant by modifying the second acoustic gain in response to a change of the first acoustic gain, and third amplifiers **17b** and **17c** having respective third acoustic gains which is variable, the third amplifiers **17b** and **17c** being adapted to amplify, according to the third acoustic gains, the digital sound signal amplified by the second amplifier **15**.

[0022]

The controller **16** includes a detecting unit **16a** for detecting the change of the first

acoustic gain, a judging unit **16b** for judging whether or not the first acoustic gain is changed on the basis of information obtained from the detecting unit **16a**, starting to compute an elapsed time when the judgment is made that the first acoustic gain is changed, and judging whether or not the computed elapsed time exceeds a predetermined value. The controller **16** is adapted to allow the second acoustic gain to be changed in response to the change of the first acoustic gain when the judgment is made by the judging unit **16b** that the computed elapsed time exceeds the predetermined value.

[0023]

When the audio mixer **10a** outputs a control signal to the controller **16**, the control signal being indicative of an instruction to change an acoustic gain, the controller **16** is adapted to change the first acoustic gain of the first amplifier **13** by controlling the first amplifier **13** in response to the control signal received from the audio mixer **10a**. When the audio mixer **10b** outputs a control signal to the controller **16**, the control signal being indicative of an instruction to change an acoustic gain, the controller **16** is adapted to change the third acoustic gain of the third amplifier **17b** by control the third amplifier **17b** in response to the control signal received from the audio mixer **10b**. When the audio mixer **10c** outputs produce a control signal to the controller **16**, the control signal being indicative of an instruction to change an acoustic gain, the controller **16** is adapted to change the third acoustic gain of the third amplifier **17c** by control the third amplifier **17c** in response to the control signal received from the audio mixer **10c**.

[0024]

Each of the audio mixers **10a**, **10b**, and **10c** includes a plurality of channel units for processing digital sound signals. Each of the channel units has a control signal producing unit for producing a control signal indicative of an instruction to the amplifier apparatus **12** to change an acoustic gain.

[0025]

The simple example of the acoustic system **1** according to the present invention is shown in FIG. **1** for easier comprehension. In this embodiment, the amplifier apparatus **12** comprises a microphone **11**, an amplifier apparatus **12**, and a plurality of audio mixers **10a**, **10b**, and **10c**. However, the practical acoustic system may comprise a plurality of amplifier apparatuses **12**, the number of the amplifier apparatuses **12** depending on the number of analog sound signals, the number of the third amplifiers **17a**, **17b**, and **17c** depending on the number of the audio mixers **10a**, **10b**, and **10c**.

[0026]

FIG. **2** is a schematic view showing, as an example, the construction of the acoustic system installed in a multipurpose hall.

[0027]

As shown in FIG. **2**, the acoustic system **1** comprises an audio mixer **10a** for processing sound signals received from microphones **11**, and outputting the processed sound signals to loudspeakers to ensure that sounds represented by the sound signals are outputted toward audiences, an audio mixer **10b** to be used as a monitor, the audio mixer **10b** being adapted to process the sound signals received from the microphones **11** to ensure that sounds represented by the processed sound signals is outputted by loudspeakers located in the vicinity of musical performers.

[0028]

The operation of the amplifier apparatus and the acoustic system according to the first embodiment of the present invention will be then described hereinafter with reference to FIGS. **1**and **3**.

[0029]

When the control signal indicative of the instruction to change an acoustic gain is inputted in the controller **16** by the audio mixer **10a** which is electrically connected as a main mixer to the amplifier apparatus **12**, the first acoustic gain of the first amplifier **13** is changed by the controller **16** (in the step **S1**). The judgment is then made by the judging unit **16b** (in the step **S2**) on whether or not the controller **16** completes the task of changing the first acoustic gain. When the judgment is made in the step **S2** that the controller **16** completes the task of changing the first acoustic gain, the controller **16** resets a timer (not shown), and start to compute the elapsed time (in the step **S3**). The judgment is made (in the step **S4**) on whether or not the elapsed time computed by the timer (not shown) exceeds a predetermined value. When the judgment is made that the elapsed time computed by the timer (not shown) exceeds a predetermined value, the controller **16** obtains a combined acoustic gain from the first and second acoustic gains, and keeps the combined acoustic gain constant by modifying the second acoustic gain (in the step **S5**).

[0030]

When, on the other hand, the control signal indicative of the instruction to change an acoustic gain is inputted into the controller **16** by the audio mixer **10b** which is electrically connected as a secondary mixer to the amplifier apparatus **12**, the controller **16** controls the third amplifier **17b** related to the audio mixer **10b** to change the third acoustic gain in response to the control signal received from the audio mixer **10b**. When the control signal indicative of the instruction to change an acoustic gain is inputted into the controller **16** by the audio mixer **10c**, the controller **16** controls the third amplifier **17c** related to the audio mixer **10c** to change the third acoustic gain in response to the control signal received from the audio mixer **10c**.

[0031]

From the above detailed description, it will be understood that the amplifier apparatus and the acoustic system according to the first embodiment of the present invention can produce digital sound signals from an analog sound signal with no analog distributor before transmitting the digital sound signals to the respective audio mixers, allow the acoustic gain to be changed by the audio mixers, and prevent the analog sound signal from being deteriorated by an analog distributor by reason that the amplifier apparatus includes a first amplifier having a first acoustic gain, the first amplifier being adapted to amplify, according to the first acoustic gain, the converted analog sound signal, an analog-to-digital converter for converting the amplified analog sound signal to a digital sound signal, a second amplifier having a second acoustic gain, the second amplifier being adapted to amplify, according to the second acoustic gain, the digital sound signal converted by the analog-to-digital converter, and a controller for obtaining a combined acoustic gain from the first and second acoustic gains, and keep the combined acoustic gain constant by modifying the second acoustic gain in response to the change of the first acoustic gain.

[0032]

The second embodiment of the amplifier apparatus and the acoustic system according to the present invention will be then described hereinafter with reference to FIG. **4**.

[0033]

As shown in FIG. **4**, the acoustic system **2** comprises a plurality of audio mixers **20a**, **20b**, and **20c**, and at least one amplifier apparatus **22** for outputting digital sound signals to the respective audio mixers **20a**, **20b**, and **20c**.

[0034]

The amplifier apparatus **22** includes a first amplifier **23** having a first acoustic gain, the first amplifier **23** being adapted to amplify an analog sound signal according to the first acoustic gain, an analog-to-digital converter **24** for converting the amplified analog sound signal to a digital sound signal, a second amplifier **25** having a second acoustic gain, the second amplifier **25** being adapted to amplify, according to the second acoustic gain, the digital sound signal converted by the analog-to-digital converter **24**, a controller **26** for obtain a combined acoustic gain from the first and second acoustic gains, and keep the combined acoustic gain constant by modifying the second acoustic gain in response to the change of the first acoustic gain, a plurality of third amplifiers **27a**, **27b**, and **27c** respectively having third acoustic gains, the third amplifiers being adapted to amplify, according to the third acoustic gains, the digital sound signal amplified by the second amplifier **25**.

[0035]

The controller **26** includes a detecting unit **26a** for detecting the change of the first acoustic gain, a judging unit **26b** for judging whether or not the first acoustic gain is changed on the basis of information received from the detecting unit **26a**, starting to compute the elapsed time when the judgment is made that the first acoustic gain is changed, and judging whether or not the computed elapsed time exceeds a predetermined value, and a setting unit **26c** for registering any one of the audio mixers **20a**, **20b**, and **20c** as a main mixer, and registering the remaining mixers as a secondary mixer. When the judgment is made by the judging unit **26b** that the computed elapsed time exceeds the predetermined value, the controller **26** is adapted to obtain a combined acoustic gain from the first and second acoustic gains, and keep the combined acoustic gain constant by controlling the second amplifier **25** in response to the change of the first acoustic gain.

[0036]

When the control signal indicative of the instruction to change an acoustic gain is inputted into the controller **26** by the audio mixer **20a** which is registered as a main mixer by the setting unit **26c**, the controller **26** controls the first amplifier **23** to change the first acoustic gain of the first amplifier **23** in response to the control signal received from the audio mixer **20a**. When, on the other hand, the control signal indicative of the instruction to change an acoustic gain is inputted into the controller **26** by the audio mixer **20b** which is registered as a secondary mixer by the setting unit **26c**, the controller **26** controls the third amplifier **27b** related to the audio mixer **20b** to change the third acoustic gain of the third amplifier **27b** in response to the control signal received from the audio mixer **20b**. When the control signal indicative of the instruction to change an acoustic gain is inputted into the controller **26** by the audio mixer **20c** which is registered as a secondary mixer by the setting unit **26c**, the controller **26** controls the third amplifier **27b** related to the audio mixer **20c** to change the third acoustic gain of the third amplifier **27b** in response to the control signal received from the audio mixer **20c**.

[0037]

From the foregoing description, it will be understood that the main mixer can change the first acoustic gain of the first amplifier **23** (equivalent to the head amplifier of the conventional acoustic system), the secondary mixers changes the respective third acoustic gains of the third amplifier **27a**, **27b**, and **27c** without changing the first acoustic gain of the first amplifier **23**.

[0038]

The operation of the amplifier apparatus and the acoustic system according to the second embodiment of the present invention will be described hereinafter.

[0039]

The steps of the second embodiment of the amplifier apparatus and the acoustic system the same as those of the first embodiment of the amplifier apparatus **12** and the acoustic system **1** will not be described hereinafter. The steps of the second embodiment of the amplifier apparatus and the acoustic system different from those of the first embodiment of the amplifier apparatus **12** and the acoustic system **1** will be described hereinafter.

[0040]

Any one of the audio mixers **20a 20b**, and **20c** is firstly registered as a main mixer in the controller **26**, while each of the remaining audio mixers **20a 20b**, and **20c** is registered as a secondary mixer.

[0041]

When the control signal indicative of an instruction to change an acoustic gain is produced and inputted into the controller **26** by the audio mixer **20a** registered the main mixer, the controller **26** is operated to obtain a combined acoustic gain from the first and second acoustic gains, and to change the first acoustic gain, in response to the control signal produced by the audio mixer **20a** registered as the main mixer, while keeping the combined acoustic gain constant.

[0042]

When, on the other hand, the control signal indicative of the instruction to change an acoustic gain is produced and inputted into the controller **26** by the audio mixer **20b** registered as the secondary mixer, the controller **26** changes the third acoustic gain of the third amplifier **27b** related to the audio mixer **20b** in response to the control signal produced by the audio mixer **20b**.

[0043]

From the foregoing description, it will be understood that the amplifier apparatus and the acoustic system according to the second embodiment of the present invention can change the acoustic gain in response to the control signal produced by each of the main and secondary mixers by reason that the amplifier apparatus is provided with a controller for changing the first acoustic gain of the first amplifier by controlling the first amplifier in response to the control signal produced by the audio mixer registered as the main mixer, and changing the third acoustic gain of the third amplifier by controlling the third amplifier in response to the control signal produced by the audio mixer registered as the secondary mixer.

[0044]

In this embodiment of the acoustic system according to the present invention, the amplifier apparatus **22** includes a controller **26**. However, the acoustic system **3** may

comprise, as shown in FIG. **5**, a plurality of amplifier apparatuses **32**, and a controller **36** externalized from the amplifier apparatuses **32**. The controller **36** may be adapted to control the amplifier apparatuses **32**. In this case, the constitutional elements of each of the amplifier apparatuses **32** is the same as those of the amplifier apparatus **22** shown in FIG. **4** except for the controller **36**. Therefore, each of the constitutional elements of the acoustic system **3** will not be described hereinafter.

INDUSTRIAL APPLICABILITY OF THE PRESENT INVENTION

[0045]

As will be seen from the foregoing description, each of the amplifier apparatus and the acoustic system according to the present invention has an effect of processing sound signals at a relatively high quality in comparison with the conventional acoustic system in which the analog sound signal is distributed to each of the head amplifiers through the analog distributor. The amplifier apparatus and the acoustic system provided with the above-mentioned amplifier apparatus are useful in a broadcast studio and a multipurpose hall by reason that the amplifier apparatus is adapted to amplify, according to an acoustic gain, an analog sound signal received from a microphone, and to allow the acoustic gain to be changed by the audio mixers.